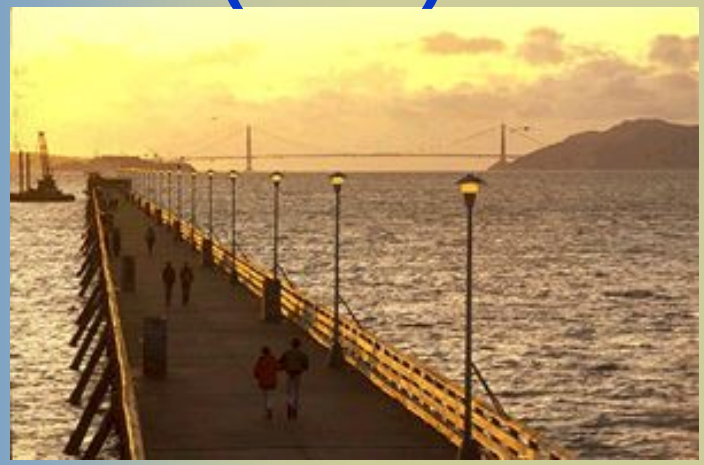
Berkeley Water Center (BWC)



Overview

- Motivation for developing the BWC
- BWC Principles, Structure and Modes of Operation
- Example of a Research Thrust Areas and associated projects

Discussion

Motivation

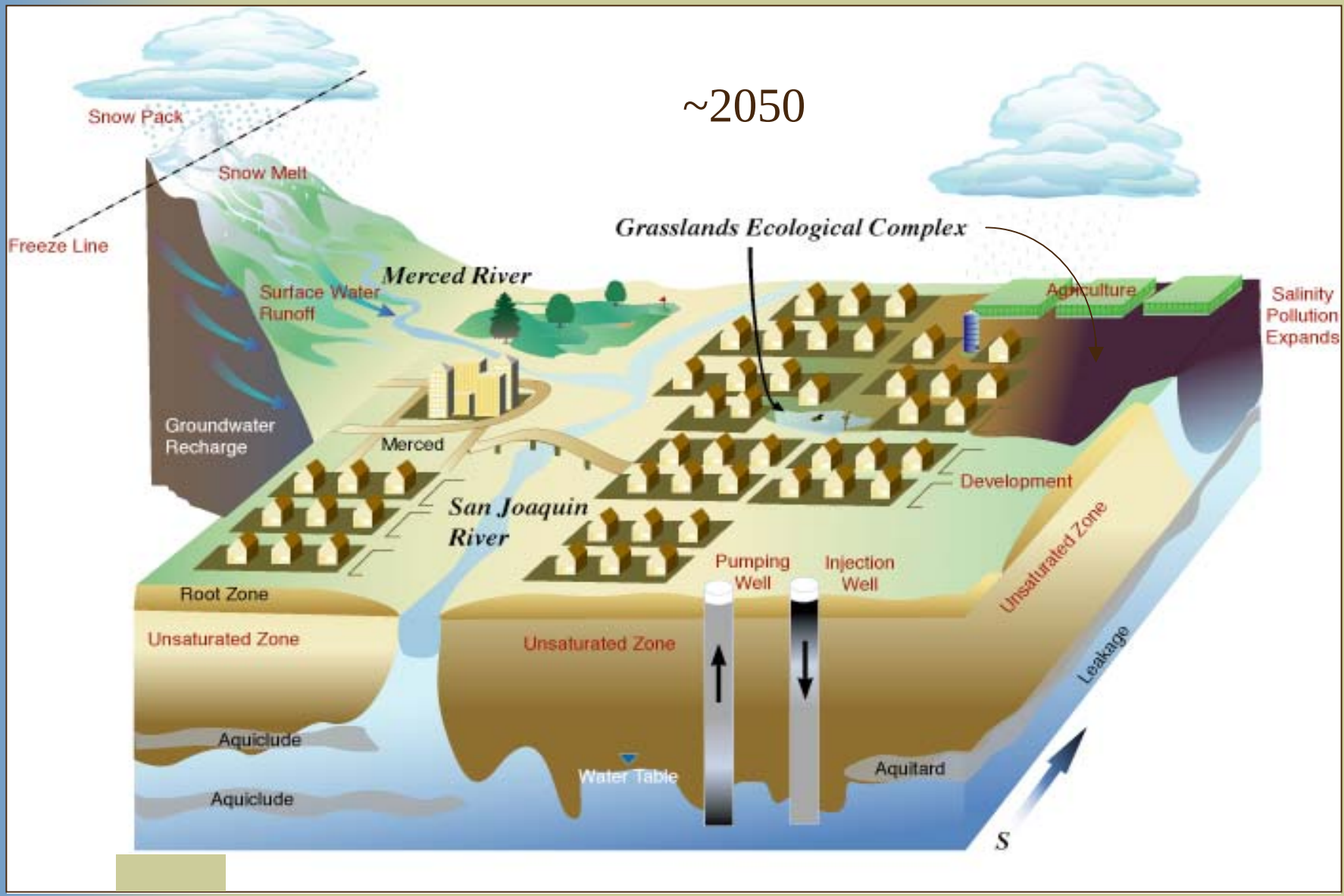
Meeting the water needs of humans is one of the greatest challenges of the 21st century;

Water management was driven until recently primarily by water supply and tackled via engineering solutions.

It is now recognized that effective water management must move beyond engineering solutions;

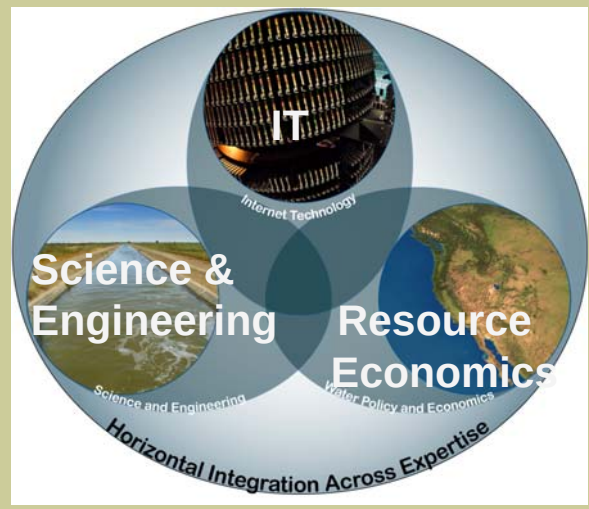
Water management is not purely an engineering, scientific, political, IT, nor an economic problem; *it is a complex, 21st Century problem that demands collaborative coordination between all of these disciplines.*

Central Valley over Time



The BWC has been developed to:

- Seek a new mode of for developing a seamless integration of UCB and LBNL water expertise;
- Focus and Coordinate Research via Research Thrust Areas ('Horizontal Integration');
- Accelerate thrust area results into applications ('Vertical Integration');
- Develop collaborations between Berkeley water researchers and other expert groups and partners;
- Function as a CITRIS institution and the water arm of the Berkeley Institute for the Environment (BIE).



BWC is comprised of researchers from:

- 3 LBNL Divisions (>200 scientists with water-related expertise);
- Several UCB Colleges and Departments (>70 faculty with water-related expertise).

BWC seeks to integrate and expand Berkeley water research and expertise:

IT

Science and Engineering

Resource Economics and Policy

BWC Structure

- **Operation**
  - Managed by IESE
  - Member of CITRIS
  - Water arm of BIE

- **Governance**
  - Executive Committee (LBNL Division directors)
  - Scientific Advisory Committee
  - External Advisory Board

- **BWC seeks to be self-supporting in 3 Years. Base support from :**
  - Strategic Partners
    - College of Engineering – XXXX/3years
    - IESE – XXXX/3 years
    - VCRO – XXXX/2 years (matching)
    - CITRIS - XXXX/3 years (projected)
    - CNR – XXXX/3 years
    - ESD through LDRD support

- **Grant support from:**
  - Research grants
  - Foundation donations.

- **Industrial and Research Partners: Two level membership**
  - Microsoft
  - Others

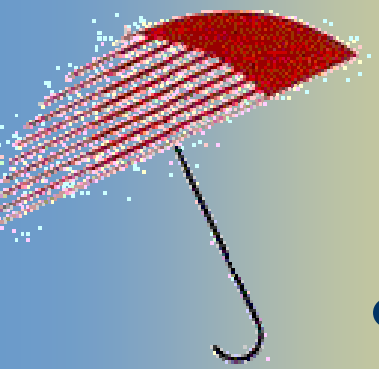
Modes of Operation

- BWC is a research development organization that is committed to developing multidisciplinary projects that have significant potential for impact and growth.

- BWC funding will be used to support
  - Working Groups
  - Seed projects
  - Postdocs
  - Visiting scientists

- Projects will be chosen through RFP process and consideration of factors such as:
  - Alignment with the mission of the Research Thrust Area (RTA);
  - Potential for Leveraging, Growth and Impact
  - Multidisciplinary

A tool for promoting and organizing multidisciplinary research: Research Thrust Areas (RTAs)



- Represent broad arenas of inquiry in which cross-cutting collaboration and cooperation that build upon Berkeley expertise and have significant potential for impact;

- Reflect the needs and interests of the water community and BWC partners.

Example: Digital Watershed RTA

Understanding hydrological processes with sufficient accuracy in the face of anthropogenic and global changes is a prerequisite to successful water management.

Development of such an understanding requires coordinated development and synthesis of data, techniques, tools, concepts, and theories.

Three key components of Digital Watershed RTA:

1. Water Technology
2. Water Cyberinfrastructure
3. Water Systems Synthesis

Example Questions associated with the Digital Watershed RTA

Water Technology

- Can novel sensor networks be utilized to autonomously measure important components of the water cycle and water quality at sufficient resolution and coverage to guide watershed management and environmental remediation? Can gray water reuse or desalinization approaches be developed that are cost-efficient?

Water Cyberinfrastructure

- Can infrastructures be developed that permits scientists and water managers to efficiently use terabytes of water data, which are distributed over various scales and forms, to determine if there will be enough water for their community and industry over the coming months or decades?

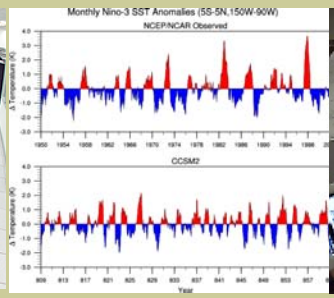
Water Synthesis

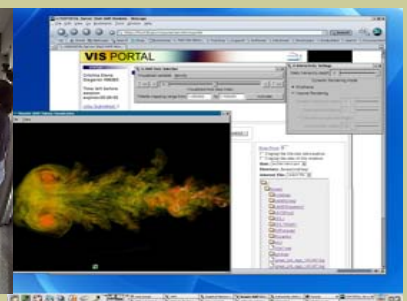
- What is the long term impact of groundwater contaminants, including emerging contaminants such as pharmaceuticals, on human and economic health of California?
- Can optimization approaches be developed to enable synchronous clean water and energy production?

Example of
Water CyberInfrastructure Project

This theme focuses on the development of cyber-infrastructure that will enable researchers (and eventually water managers) to:

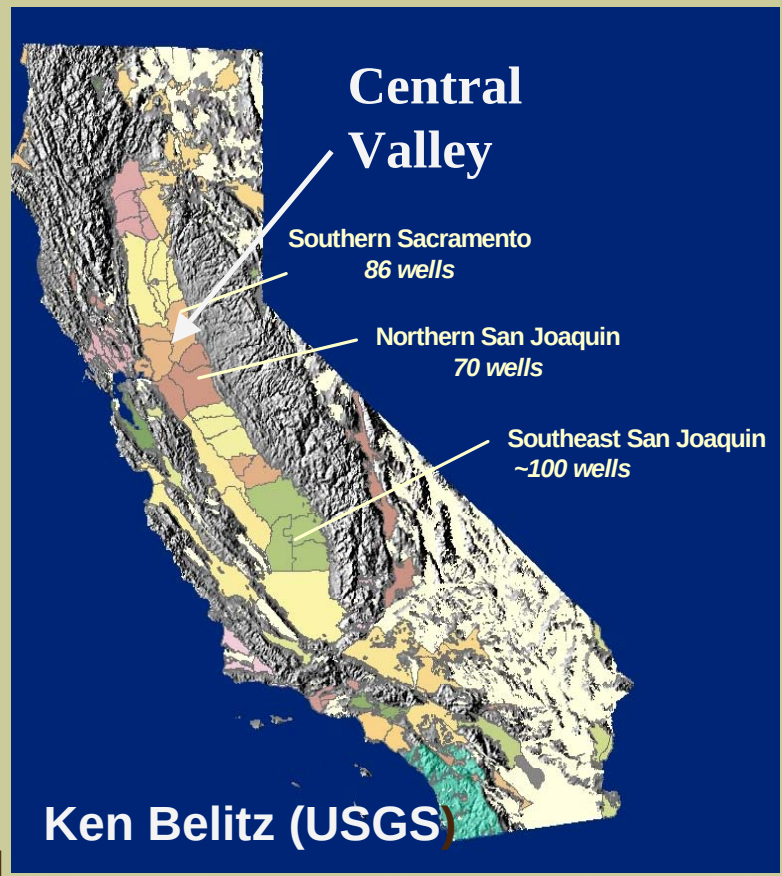
- curate and assimilate complex, multi-scale watershed datasets;
- use datasets with linked modeling or mining tools to test hypotheses and eventually to facilitate decision making;
- Link watershed and climate data and tools.





Central Valley
Water Resources and Quality

- Across the US, **groundwater supplies roughly 40 percent** of drinking water;
- The State of California alone uses about 16 Million acre-feet of ground water each year, **more than any other State in the Nation, and 80% of that goes toward crop irrigation;**
- The 400 Mile long Central Valley supplies ¼ of the food in the US.
- California Groundwater quantity and quality is **critical to the economic viability of the state;**
- Recognizing this importance, USGS has developed a **$50 Million program** focusing on CA water quality monitoring.
- Microsoft TCI will build **Central Valley Cyaberisfrastructure**, and **BWC scientists** will use infrastructure to address critical water problems.



USGS science for a changing world

Berkeley
University of California

Distributed Central Valley Data Sets

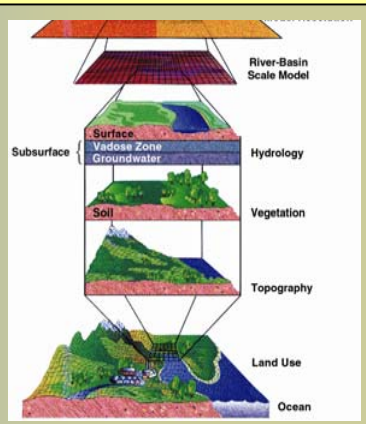
USGS science for a changing world

CIMIS

NAS

Department of Water Resources

Data Harvesting and Transformations

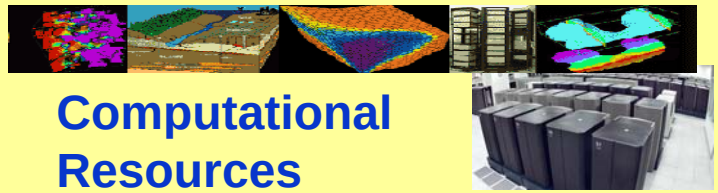


BWC Data Gateway

BWC Analysis Gateway

Data Cleaning, Models, Analysis Tools

Computational Resources



BWC Water Portal

Knowledge discovery, Hypothesis testing, Water Synthesis

Dissemination and Archiving

Central Valley Portal

Microsoft

Berkeley
University of California

Distributed Central Valley Data Sets

USGS science for a changing world

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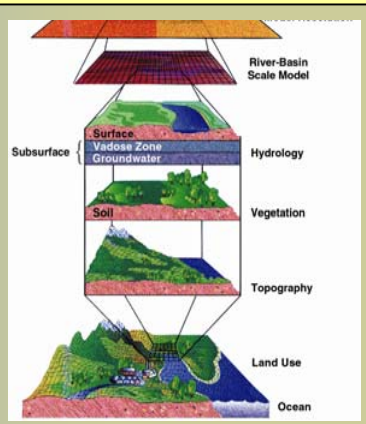

BWC Data Gateway

BWC Analysis Gateway

Data Cleaning, Models, Analysis Tools

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BWC Water Portal

Knowledge discovery, Hypothesis testing, Water Synthesis

ESD LDRD

Dissemination and Archiving

Central Valley Portal

Microsoft

Example of Water Synthesis Project: ESD LDRD

- Development of coupled codes to simulate flow and transport of and nitrate through the entire system (climate, land surface, subsurface and vegetation).
- Explore how water resources and quality (N cycling) vary in Central Valley as a function of:
  - climate change,
  - land-use, and
  - population growth
- Project will advance science while leveraging on USGS, DWR, and Microsoft projects

Tough2-CLM codes
couple water and energy

↕

TOUGHREACT and RUNCH codes
reactive biogeochemical transport

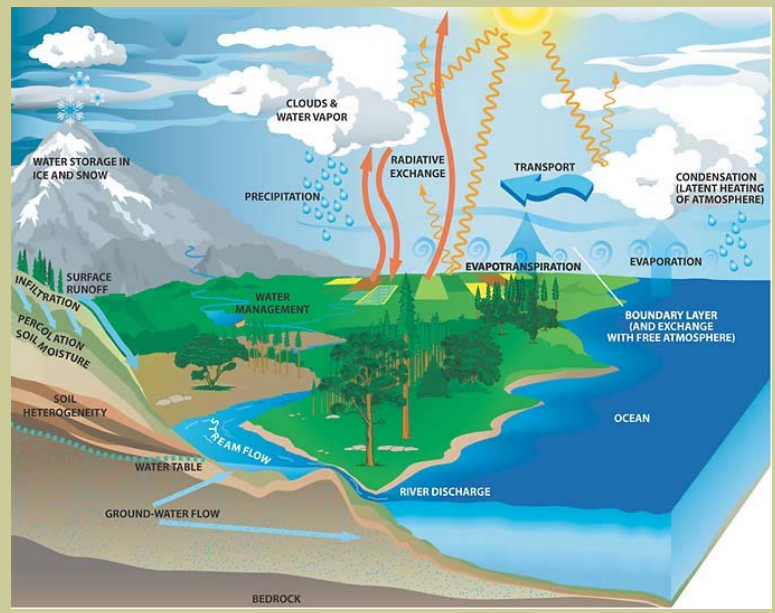
↕

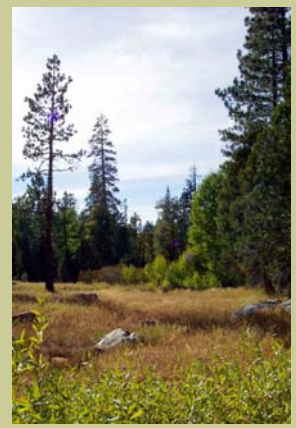
CLM modules
isotopic and root-distribution dependence on ET

LDRD: New coupled codes and application to Central Valley

HydroWatch: Sensors to Cyberinfrastructure

- Funded by Keck Foundation (1.6M over 4 years) to BIE;
- PIs: Kirchner, Cohen, Culler and DePaulo;
- Will expand observations of water cycle components by developing wireless sensors and techniques to monitor water quality, quantity, and pathways;
- Field deployment of these new sensors within wireless network will occur within two small (~10-10^2 km^2), hydrologically different CA sites of the UC Natural Reserve System;
- BWC will work with HydroWatch and Microsoft to explore project data infrastructure needs – LEVERAGING and COLLABORATION





Example of Water Synthesis Project: Proposed EETD Strategic LDRD

- Although water and energy systems are coupled, planning and management of these systems is currently performed independently.

- DOE anticipates that 550 more nuclear power plants will be needed by 2050. Siting new plants requires *geological site characterization* and *reliable water availability* up to 50-60 years in the future.
  - Can water planning be effectively incorporated into energy planning to address all related risks (i.e., climate change, water supply, energy supply, energy prices)?

Decision Support for Joint Optimal Control of Energy and Water Systems

- **Strategic LDRD**: EETD (J. McMahon), CRD (J. Meza), ESD (B. Faybishenko) and others

- **LDRD Components:**
  - Identify key interdependences of energy and water for given system (i.e., Central Valley) and develop coupled process models;
  - Characterize key uncertainties
  - Develop integrated, simulation-based optimization tool under conditions of uncertainty.
  - Assess sustainability and economic impacts to Central Valley (agricultural productivity, net electricity generation)

- **Leveraging and Growth Opportunities**
  - CEC and BES Water Energy Areas
  - BWC Digital Watershed and Central Valley projects.

Discussion

FEEDBACK?

- Benefits to LBNL:
  - Integration and expansion of water expertise through collaboration with UCB and BWC partners;
  - LBNL division directors on advisory board;
  - Open RFP process for LBNL scientists;
  - Opportunity to create projects/RTAs of interest to LBNL (water-energy) and that may help to attract associated funding (CEC);
- How can we best:
  - Create ‘seamless’ integration of water expertise with campus and an equitable partnership?